1 Summary

1.1 Project Context

The information gap between virtual product and manufacturing engineering and the physical start of production is a fundamental problem for European manufacturers. Knowledge about products and processes, which is currently distributed over heterogeneous systems, is rich of information, but a platform for presenting this knowledge according to the different user roles (e.g. manufacturing system engineer or operator) is missing. Enterprise data must be captured, updated, enriched and transferred into an interoperable platform, which enables cross-disciplinary knowledge sharing throughout the product life cycle.

Up to now, the complexity and incompatibility of digital data are the main reasons why planning and training of manual manufacturing processes, e.g. in automotive and aerospace, are still carried out in physical stages. This training method is expensive and often ineffective. In order to reduce the need for physical prototypes and to speed up time-to-market, virtual training must overcome the problems of former approaches, such as inadequate authoring times, cost-prohibitive hardware and insufficient user integration.

1.2 Project Objectives

The overall aim of the VISTRA project is to minimize the number of physical prototypes in manufacturing by developing a user-centred simulation and training platform on the basis of available product and process data. The knowledge and feedback captured by the simulation and training platform should be (re-)used in different phases of the product lifecycle.

The overall aim is divided into the following strategic objectives:

1. **Data Mining and Harmonization from Product and Manufacturing Enterprise Data**
Exploration of effective and efficient mechanisms for the integration of highly complex and partly very extensive product and engineering data from heterogeneous data sources (e.g. PLM, ERP, PPS) into downstream manufacturing processes. Relevant information (e.g. product models, process and workflow information) must be filtered out of huge amounts of data and harmonized for further usage. Respective methods and algorithms have to be identified and adapted.
2. **Acquisition and Representation of Cross-disciplinary Knowledge**
Development of a method for modelling and refinement of an interoperable knowledge representation for manual assembly tasks, using captured product and engineering data. The knowledge model can be used for various purposes (e.g. training). The manual effort in adaption and regeneration of engineering data should be kept to a minimum.
3. **Interactive Environments with High User Acceptance**
Design of intuitive and robust human-machine-interfaces that can be integrated into the domain of virtual training. The user must be able to interact with the virtual environment in real-time and receive an immediate and adequate feedback. Advanced multimedia technologies and game-based learning concepts will also be considered (compare Figure 1).
4. **Physical behaviour and Optimized Real-time Simulation of Deformables in Virtual Training**
The real-time simulation of flexible parts, e.g. cables, hoses and complex wiring harnesses, for interactive virtual training must be investigated and integrated into the virtual environment in order to create a realistic user experience and to reduce the need for physical assembly testing. The evaluation criteria for the treatment of realistic behaviour versus simulation speed have to be identified.
5. **Reuse of Knowledge and Cross-disciplinary Knowledge Sharing**
The potential cross-disciplinary usage of manufacturing knowledge e.g. workflow data, process specifications and training feedback, must be investigated and identified. Interfaces have to be developed to hand back knowledge to upstream engineering processes (e.g. product design, manufacturing planning) in order to support design and planning decisions.

6. Applicability in Real Industrial Environments

The integration of the before mentioned aspects into a complete and sound prototype system. The applicability of the system must be proved and validated in close collaboration between the end-user and the technology providers. The developed system must be easy to integrate into the pre-existing manufacturing infrastructure.

7. Interoperability and Standardization

The exploitation of the developed systems is a key concern of the project. A generic and interoperable solution suitable for all types of enterprises, which can be used in broad application areas, must be developed. This includes also international standardization on how to model assembly processes into an exchangeable and interoperable manner with explicit semantics in order to ease data re-use for other applications.

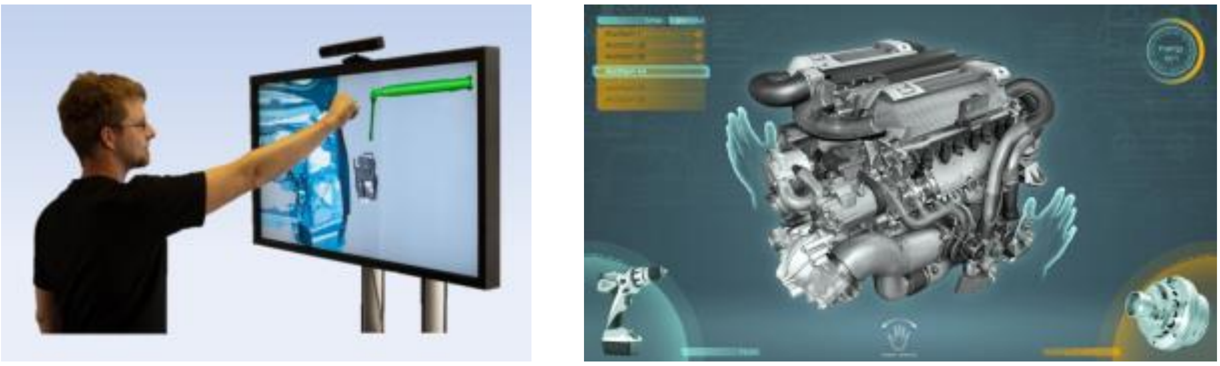

Figure 1: Interaction Concept for Virtual Assembly Training

1.3 Project Progress

During the first six months of the project, the focus was set on two issues:

- collecting the requirements for virtual simulation and training in manufacturing environments, and
- defining the technical specifications for the VISTRA system.

First the **system requirements** were derived in close cooperation between the end-users and the technical partners by means of extensive user analyses. The requirements are ensured to reflect a system of practical usage, by combining the required system capabilities given by the end-users with the expertise of the technology provider about the feasibility. Based on this information, the **technical specifications** of the VISTRA system were compiled as a set of deliverables, which represents a guideline for the subsequent development phase, and thus helps to keep track of the further project progress.

Simultaneously, the first dissemination and exploitation activities have been carried out. As a first step, the official VISTRA project website has been set-up as part of the dissemination strategy to raise the awareness, publicity and visibility of the project. Additional media (such as posters, flyers and factsheets) was designed to further promote the project. Moreover, the project idea was presented at relevant conferences and events as well as in public media.

Additionally, the project risk plan has been updated in respect to the elaborated system specifications. Ethical considerations associated with different phases of the VISTRA project (e.g. development, evaluation and execution) were identified and a methodology for the user selection and involvement was defined.

Finally, the VISTRA Technical Advisory Board was constituted. It consists of several industrial and academic experts, which agreed to follow the project development and to advise the Steering Board.

During the project month 7 and project month 15, the focus was set on five issues:

- **Finalising the system specifications and mock-ups for the VISTRA Training Simulator (VTS) and VISTRA Knowledge Sharing Center (VKSC),**
- **Development of the individual system components,**
- **Integration towards the first, integrated VISTRA demonstrator,**

- **Design of an evaluation process, and**
- **Intensification of dissemination, exploitation and collaboration activities.**

First the **system specifications** were updated (e.g. D2.4 “Basis Data Structure and Selection” was refined based on the expert feedback of the first review) and a concept for knowledge sharing (see D4.1 “Concept on Knowledge Sharing”) and the game-based training (see D2.7 “Game Design Document”) were introduced. Based on the theoretical concepts, mock-ups for the VKSC (see D4.2 “Initial version of the VISTRA Knowledge Sharing Center”) and the VTS (see D7.1 “First VISTRA Visuals”) have been drafted.

Furthermore, the **technical development** of the individual system components has started:

- In WP3 the **VISTRA Knowledge Platform (VKP)** was developed as the central data hub in the VISTRA system. The VKP is based on a semantic data model, which describes all required training data. Additionally an import mechanism was set up, which automatically maps structural enterprise data (from the end-users OPEL and VOLVO) into the VISTRA data model. For the import of geometry data, a converter was developed to automatically transform CAD-data into the required VR data format. Finally, a flexible web service interface was developed, which allows to forward/receive data to/from the VKSC and the VTS. The entire VKP data pipeline – from the automatic import of enterprise data to the data provision/reception by web services – has been successfully integrated and tested (see D3.1 Initial Version of VISTRA Knowledge Platform).
- In WP4, a detailed concept of the **VISTRA Knowledge Sharing Center (VKSC)** was elaborated, which – in a next step – will be realized and integrated in the overall VISTRA system (see D4.2 “Initial version of the VISTRA Knowledge Sharing Center”).
- In WP5, a first **prototype for user-interaction** was developed (see D5.1 “Basic User-Interaction Prototype”) and integrated as a proof-of-concept into a basic virtual training environment (see D5.2 “Integrated Interaction Mock-up”).
- In WP6, the **flexible part engine** was developed and prepared for the integration into the VISTRA system (see D6.2 “Dynamically Linked Library Containing the Flexible Simulation Engine” and D6.3 “Performance Improvement in Simulation Engine Trading Accuracy for Speed”). This includes also a mechanism for the creation and exchange of flexible parts (see D6.4 “Possibility to Create Complex Wiring Harness in IPS” and D6.5 “Initial Export of Authoring Data”). Additionally, an overview about capabilities and needs of physics-based simulation was given (see D6.1 “State-of-the-Art in Academic and Industrial Simulation Methods and Tools”).
- In WP7, the development of the **VISTRA Training Simulator (VTS)** and **overall VISTRA system** has started according to the pre-assigned specifications and by integrating the outcome of WP3, WP4, WP5 and WP6.

In the second project period, also an appropriate **evaluation process** was designed in collaboration with the end-users in order to validate the future VISTRA system against the user requirements (see D8.2 “User Selection for Tests”).

Simultaneously, the **dissemination, exploitation and collaboration activities** have been intensified. The contact to the partner projects *ActionPlanT* and *Know-4-Car* has been established. Moreover, the VISTRA-IMS initiative has started successfully as part of the *Intelligent Manufacturing Systems* (IMS) program in the area of *Innovation, Competence Development and Education* (see D9.10 “Start of the VISTRA-IMS initiative”). The initiative extends the scope of VISTRA-FP7 by new application areas (e.g. academic usage), by more generic training, learning and assistance concepts and by international dissemination and exploitation activities (e.g. new potential end-users). Finally, the VISTRA *Technical Advisory Board* (TAB) has taken up work and has provided feedback related to the project development. The official VISTRA project website has been updated and extended e.g. by sections for project results, project supporters and project networks. Moreover, the idea and concepts of the project were presented at relevant conferences and events as well as in public media. The planning for one specific exploitation event has been elaborated (D9.7 “Conference Planning”) and the dissemination and exploitation plans for the next project period were updated (D9.8 “Dissemination Plan – Update II” and D9.9 “Exploitation Plan – Update II”). In this context, also the IPR of the project has been further clarified and reinforced. A standardisation plan was created in order to investigate and to plan ahead the potential for standardization in the VISTRA project (see D9.11 “Standardization Plan”). Finally, a long term vision on the topic on industrial training, assistance and knowledge sharing was provided in D9.12 “VISTRA Roadmap”.

1.4 Project Impact

The VISTRA project is highly industry-driven, addressing specific needs of OEM manufacturers in Europe. The two industry partners, OPEL and VOLVO, are facing the same main issues when it gets to the simulation and training of future assembly processes for a new product. At the moment the training is realized using hardware components in the form of complex physical prototypes. This training method is ineffective due to low availability of the physical training equipment. Ineffective training causes too long and unpredictable ramp-up phases characterized by suboptimal equipment availability, poor quality rates and the need of internal rework. Furthermore, it decreases the effect of operator feedback on the product development as it is generally too late to consider the improving suggestions that come to the operator’s mind during training.

VISTRA will enable manufacturers to use already existing product and process data to generate virtual simulation and training setups of manual assembly processes with less or no authoring effort at all. In this way, VISTRA will accelerate product design and manufacturing by enabling new and complex products to be ramped up significantly faster. The early training in an interactive and virtual environment will allow to gain valuable feedback and suggestions for improvements in full complex product design and manufacturing processes. The VISTRA solution will permit to make decisions in the early design phases, leading to faster availability of the assembly lines and better quality rates during the series production.

1.5 Project Consortium

The development of the VISTRA technology requires a unique mix of expertise in very different areas of research and development. The industry-driven project character is furthermore reflected by the well-balanced project consortium (compare Table 1). The integration of the work of the research institutions in a single platform is done by a SME, specialized in the development of games, simulations and virtual worlds. The final implementation of the platform takes place at several sites of two car manufacturers, where the VISTRA Virtual Training Simulator will strongly affect the future assembly and training processes.

Table 1: The Partners of the VISTRA consortium

Participant No.	Participant Organisation Name	Short Name	Country
1 (Coordinator)	DEUTSCHES FORSCHUNGSZENTRUM FUER KUENSTLICHE INTELLIGENZ GMBH	DFKI	Germany (DE)
2	Fraunhofer-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Fraunhofer	Germany (DE)
3	STIFTELSEN Fraunhofer-CHALMERS CENTRUM FOR INDUSTRIMATEMATIK	FCC	Sweden (SE)
4	THE UNIVERSITY OF NOTTINGHAM	UNott	United Kingdom (UK)
5	Serious Games Interactive	SGI	Denmark (DK)
6	VOLVO TECHNOLOGY AB	VOLVO	Sweden (SE)
7	ADAM OPEL AG	OPEL	Germany (DE)

1.6 More Information

The VISTRA project has set up a public website http://www.vistra-project.eu, which provides a short overview of the projects, its status and current achievements.

More information can also be acquired by contacting the project coordinator and technical coordinator.

	Project Coordinator	***Technical Coordinator***
	Dr. Jochen Schlick	Frank Arlt
Address:	DFKI	Adam OPEL AG
	Trippstadter Straße 122	Bahnhofsplatz
	D-67663 Kaiserslautern, Germany	D- 65423 Rüsselsheim am Main
Phone:	(+49) 631-20575-3405	+49(0) 6142-7-67665
Email:	jochen.schlick@dfki.de	Frank.Arlt@de.OPEL.com
Fax:	(+49) 631-20575-3402	+49(0) 6142-7-67659